

CDS130 Final exam (PART I)

The final exam consists of two sections. The first section is a closed-book paper exam (60 minutes); and the second section involves use of Matlab on the computer (75 minutes). The following part is the first section of the exam.

- Be sure your exam booklet has 9 pages for this section.
- Write your name at the top of each page.
- This is a closed book exam.
- All computational commands and statements appearing in this exam are specifically referring to the Matlab programming language taught in class.
- You may not use Matlab on the computer during this section.
- Absolutely no interaction between students is allowed.
- Each question is worth 5 points. Partial credit may be awarded ONLY if work is shown.
- Duration for this section: 60 minutes (10:30am – 11:30am).

Q1. Colors can be specified by RGB triples in Matlab. For example, the red, green, blue colors can be represented by

Red = [1, 0, 0];
Green = [0, 1, 0];
Blue = [0, 0, 1];

NewColor = (Red*0.5) & (Green*0.5) | Blue

What is the color of the combination of the Red, Green, Blue colors specified above? i.e., what is the color of NewColor?

- (A) Black
- (B) Red
- (C) Green
- (D) Blue
- (E) None of the above

Answer: _____

Q2. A matrix was generated using

M = rand(4);

Which of the following statements is valid in Matlab?

- (A) M(3,2)
- (B) M(0)+M(4)
- (C) exp(M)
- (D) M(1:2; :)^2
- (E) None of the above

Answer_____

Q3. What is the result of running the following Matlab code:

```
clear;
```

```
M = [ 1 2 -3 0 4 5 0 -7 6 10;  
      -3 4 -1 7 3 2 9 5 6 0;  
      0 0 0 -1 1 -2 2 -3 3 4];
```

```
counter = 0;
```

```
for i = 1:3
```

```
    for j = 10:-1:1
```

```
        if M(i,j) <= 0
```

```
            counter = counter + 1;
```

```
        end
```

```
    end
```

```
end
```

```
counter
```

- A) counter = 8
- B) counter = 6
- C) counter = 13
- D) counter = 23
- E) None of the above

Answer:_____

Q4. In order to print formatted integers with the following format,

5.00000

6.00000

7.00000

8.00000

9.00000

10.00000

which fprintf statement could be used in the following code?

```
for i=5:10
    fprintf(      )
end
```

- (A) fprintf('%8.5f\n', i)
- (B) fprintf('%5.2f\n', i)
- (C) fprintf('%5.5d\n', i)
- (D) fprintf('%f\n', i)
- (E) None of the above

Answer: _____

Q5. Involving fprintf and nested for-loop commands, write a Matlab script to print the following pattern:

```
1
21
321
4321
54321
654321
7654321
```

Answer:

Q6. What is the result of running the following Matlab code:

```
clear;
M = [ 1 2 -3 0 4 5 0 -7 6 10;
      -3 4 -1 7 3 2 9 5 6 0;
      0 0 0 -1 1 -2 2 -3 3 4];

counter = 0;
for i = 1:3
    for j = 1:10
        if M(i,j) ~= 0
            counter = counter - 1;
        end
    end
end
counter = counter*2
```

- A) counter = -24
- B) counter = 24
- C) counter = -12
- D) counter = -48
- E) None of the above

Answer_____

Q7. Given the following Matlab code,

```
clear;  
k= 0;  
while k ^2 -1 < k  
    k = k + 1;  
end  
k
```

what is the value of k after executing the code ?

- (A) 0
- (B) 1
- (C) 2
- (D) 3
- (E) 4

Answer:

Q8. Using nested for-loops to generate a matrix that has elements shown below (without typing the numbers explicitly):

$$A = \begin{pmatrix} 1 & 10 & 100 & 1000 \\ 0.1 & 1 & 10 & 100 \\ 0.01 & 0.1 & 1 & 10 \\ 0.001 & 0.01 & 0.1 & 1 \end{pmatrix}$$

Q9. Given vectors $x=[-1, 2, 3, -2]$, $y=[0.2, 3.1, 0, -3]$ and $z=[3, 0, 1, 0.1]$, provide answers to the following operations

(A) $(x > y) \& z$

(B) $(x > 1) + (y < 0) + \sim z$

Q10. Images in Matlab are represented by matrices. In order to properly display the image with desired colors, a color map is needed (for indexed images). Given a matrix

$$M = \begin{pmatrix} 0.1 & 0.5 & 0.7 \\ 0.9 & 0.4 & 0.6 \\ 0.5 & 0.8 & 0.2 \end{pmatrix}$$

with the following Matlab code:

```
M=[0.1, 0.5, 0.7; 0.9, 0.4, 0.6; 0.5, 0.8, 0.2];
colormap(M);
imagesc(M>0.5 + M >0.7 )
axis square off
```

Which of the following statements is most likely correct?

(A) No image will be produced, because the colormap is not properly assigned.

(B) The following image will be produced:



(C)

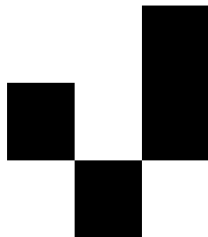
(C) The following 3-color image will be produced:



(D) The following 2-color image will be produced:



(E) The following white and black image will be produced:

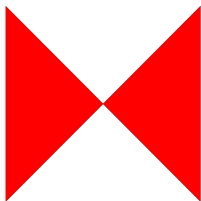


Answer: _____

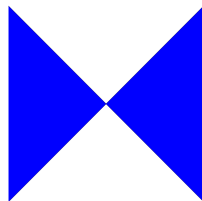
Q11. The 'fill' command can be used to plot polygons with filled colors. Which plot will be generated by executing the following command lines?

```
clear;
fill([0, 1, 1, 0], [0, 1, 0, 1], [0,0,1]);
axis square off;
```

(A)



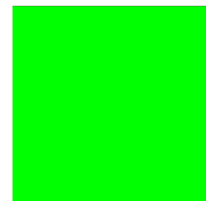
(B)



(C)



(D)



Answer: ____

Q12. Write a Matlab code to find the largest integer i to satisfy the following inequality:

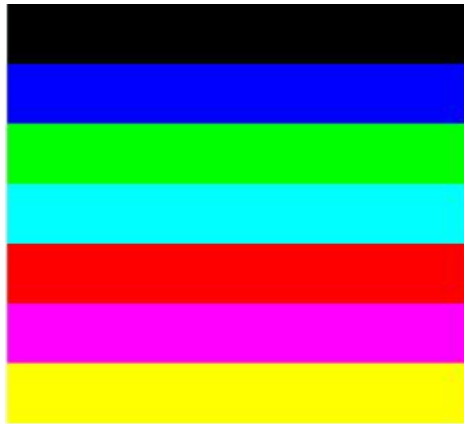
$$3*(2+1)+4*(3+2+1)+5*(4+3+2+1)+6*(5+4+...+1)+i*[(i-1)+(i-2)+...+1]<100000$$

Sample: CDS130 Final exam (PART II)

The final exam consists of two sections. The first section is a closed-book paper exam (60 minutes); and the second section involves use of Matlab on the computer (75 minutes). The following part is the second section of the exam.

- Make sure you have 3 pages for this section.
- You are required to use Matlab to solve the problems.
- Absolutely no interaction between students is allowed.
- Partial credit may be awarded **ONLY** if work is shown.
- Turn in your Matlab code and final answers by email (hsheng@gmu.edu) or in paper form.
- Duration for this section: 75 minutes (11:30am – 12:45am).

Q1. (15 points) Write a Matlab script to create an image as follows: (Note: you need to provide seven colors and the correct orientation of the strips.)



Q2. (10 points) Given a mathematical function $f(x) = \frac{1}{x} \exp[-(\ln(x)-1)^2]$, calculate the area underneath the curve from $x=1$ to $x=12$.

Q3 (15 points) Suppose a colony of 500 bacteria is multiplying at the rate of $r = 0.8$ per hour per individual (i.e., an individual produces an average of 0.8 offspring every hour). After 10 hours, bacteria run out of nutrient and begin to die. Assuming the bacterial death rate at this stage is 1.2 (and the multiplication process continues), predict the number of bacteria at different hours, and report the number of bacteria at 15th hour.